ELECTROLUMINESCENT APPARATUS AND METHODS OF MANUFACTURING AND ENCAPSULATING

FIELD OF THE INVENTION

This invention relates generally to the field of electroluminescent apparatus and, more particularly, to organic electroluminescent apparatus and improved methods of manufacturing and encapsulating organic electroluminescent apparatus.

BACKGROUND OF THE INVENTION

Electroluminescent (EL) apparatus may be classified as organic or inorganic. Electroluminescent apparatus exhibit high visibility due to inherent self-emission characteristics and provide excellent impact resistance and handling ability. As a result, research, development and practical utilization of EL apparatus as a pixel for graphic display, a pixel for a television image display and as a light source are currently underway.

Organic EL apparatus include a laminate structure having, among other things, a light-emitting layer formed of a fluorescent organic solid and deposited between a pair of electrodes. This laminate structure is normally formed on a substrate such as glass. The foregoing type of organic EL apparatus utilize light emission provided when electrons injected into the light-emitting layer are recombined. As a result, organic EL apparatus actuates at a low voltage and exhibits a level of brightness proportional to the injected electric current. By changing the type of fluorescent organic solids comprising the light-emitting layer, light emission may be obtained through substantially the entire visible light region.

The fluorescent organic solids commonly used to form the light-emitting layer of organic EL apparatus are susceptible to water, oxygen and other environmental elements. Furthermore, the electrode normally formed on the light-emitting layer is also prone to oxidation from exposure to water, oxygen, etc. As a result, conventional organic EL apparatus exhibit a short life as a usable device in atmospheric conditions. To increase the life of organic EL apparatus, the electrode and the light emitting layer must be protected from water, oxygen and other environmental elements.

To increase the life of organic EL apparatus in this regard, various methods and techniques have been devised for encapsulating organic EL apparatus with protective layers of varying compositions. Although exemplary, such methods and techniques are difficult and expensive to implement, require specialized processing equipment or techniques, and/or yield largely nominal results.

Accordingly, it would be highly desirable to provide an improved organic EL apparatus and improved methods of encapsulating organic EL apparatus.

It is a purpose of the present invention to provide a new and improved method of encapsulating organic EL apparatus.

It is another purpose of the present invention to provide a new and improved method of encapsulating organic EL apparatus that is easy to implement.

It is still another purpose of the present invention to provide a new and improved method of encapsulating organic EL apparatus that is inexpensive.

It is a further purpose of the present invention to provide a new and improved organic EL apparatus that is inexpensive and highly resistant to water, oxygen and other environmental elements.

SUMMARY OF THE INVENTION

The above problems and others are at least partially solved and the above purposes and others are realized in new and improved packaged organic EL apparatus (herein including one or more EL devices or pixels on one or more substrates) and improved methods of manufacturing and encapsulating organic EL apparatus. In a specific embodiment, packaged organic EL apparatus is generally comprised of an organic electroluminescent device carried by a glass substrate and a glass cover sealed with the glass substrate at a perimeter seal bounding the organic electroluminescent device in a cavity. The perimeter seal is generally comprised of a cured epoxy adhesive seal sealingly engaging the glass cover with the glass substrate, and desiccant and/or inert fluorocarbon liquid disposed proximate the cured epoxy adhesive.

Consistent with the foregoing, associated methods of manufacturing and encapsulating organic EL apparatus may also be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and further and more specific objects and advantages of the instant invention will become readily apparent to those skilled in the art from the following detailed description thereof taken in conjunction with the drawings in which:

FIG. **1** illustrates a sectional view of organic EL apparatus and a cover spaced from organic EL apparatus, in accordance with the present invention;

FIG. **2** illustrates a sectional view of organic EL apparatus of FIG. **1** as it would appear packaged or otherwise encapsulated with the cover;

FIG. **3** illustrates a bottom plan view of the cover of FIG. **1**; and

FIG. **4** illustrates a sectional view of a press for pressing the cover against organic EL apparatus of FIG. **1**.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The present invention provides, among other things, improved packaged organic EL apparatus and improved methods of manufacturing and encapsulating organic EL apparatus (herein including one or more EL devices or pixels on one or more substrates) and, more particularly, encapsulating active organic regions of organic EL apparatus. The present invention incorporates a glass-to-glass encapsulation scheme including, among other things, a thin film or layer of desiccant and/or inert fluorocarbon liquid in combination with a UV light-cured perimeter seal to bound at least an active organic region of an organic EL device in an environmentally controlled cavity.

Turning to FIG. **1**, illustrated is a sectional view of an organic EL apparatus **10** and a cover **11** spaced from apparatus **10**, in accordance with the present invention. Apparatus **10** is generally comprised of a laminate structure mounted with a glass substrate **12**, the laminate structure generally defining an organic EL device **13** having, in this specific example, a display area or active organic region generally denoted at **14**. While a single EL device **13** is disclosed herein for simplicity, it will be understood that single or multiple EL devices can be incorporated. The various structural features of apparatus **10** represent con-